Summary Report - Addtional Research
Pennichuck Water System
Nashua, New Hampshire

Submitted to:
City of Nashua

January 30, 2003

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 Introduction

Rizzo Associates, Inc., and Hartman & Associates, Inc. were contracted by the City of Nashua to continue the review and evaluation of the acquisition of Pennichuck Corporation by Philadelphia Suburban Corporation (N.H. Public Utility Commission's Docket No. DW 02-126). The original work, presented to the city on November 1, 2002, focused on the portion of the system that supplies water to the City of Nashua. This document has been prepared to provide additional information on the portions of the water system outside the City.

1.1 Purpose of Study

The purpose of this study is to evaluate those portions of Pennichuck Corporation that provide water services or operations outside Nashua. By way of background the next section describes the entities covered in this report and there relation to Pennichuck Corporation. For further background information refer to the November 1, 2002 report.

1.2 Pennichuck Corporation Background

The Pennichuck Corporation ("Pennichuck") is a holding company that owns the following five subsidiary companies.

Pennichuck Water Works, Inc. ("Pennichuck Water Works")

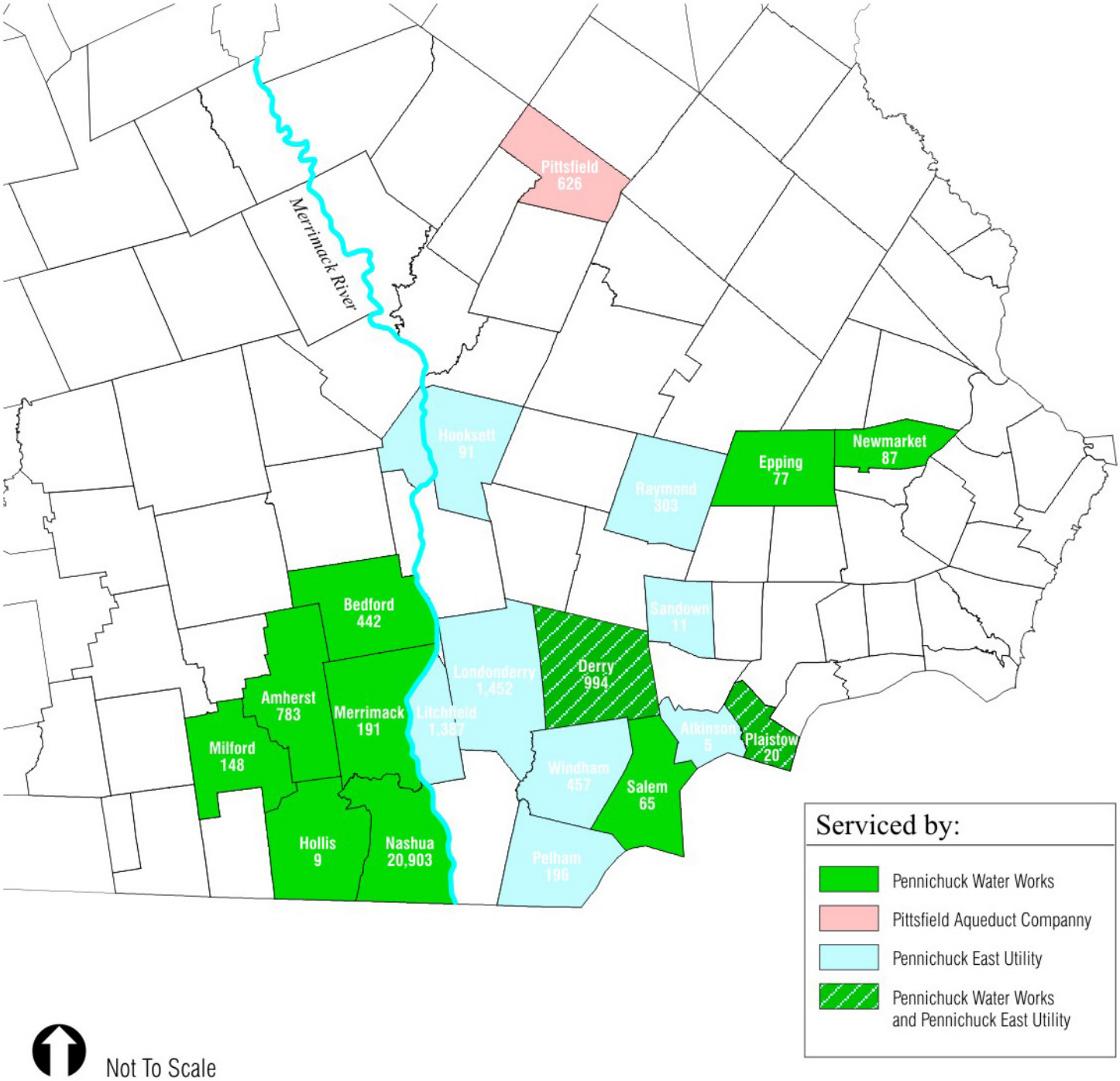
Pennichuck East Utility, Inc. ("Pennichuck East")

Pittsfield Aqueduct Company, Inc. ("Pittsfield")

The Southwood Corporation ("Southwood")

Pennichuck Water Service Corporation ("Service Corp.")

Pennichuck Water Works, Pennichuck East and Pittsfield are water utilities that are regulated by the New Hampshire Public Utilities Commission (PUC). The service area for each of the water utilities is shown in Figure 1-1. As shown in Figure 1.1, Pennichuck Water Works serves Nashua and several surrounding communities. It is the other two utilities that are the focus of this report. Table 1-1 shows the relative size of the three utilities in terms of customers.



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Water Service Areas -
Pennichuck Corporatrion

Figure 1-1

Table 1-1 Pennichuck Corporation Water Utilities

Subsidiary	Approximate Number of Customers
1. Pennichuck Water Works	23,600
2. Pennichuck East	4,300
3. Pittsfield	600

Each of the five subsidiaries are described below.

Pennichuck Water Works, Inc. provides water to the City of Nashua and limited areas in Amherst, Merrimack, Milford, Hollis, Bedford, Derry, Plaistow, Epping, Salem and Newmarket. The primary sources of water for the Pennichuck Water Works include the Pennichuck Brook, Merrimack River and well fields.

Pennichuck East Utility, Inc. supplies water to the Towns of Litchfield, Pelham, Windham, Londonderry, Derry, Hooksett, Sandown, Raymond, Plaistow and Atkinson. The sources of water for Pennichuck East are a number of wells throughout the communities that are served. This water is supplemented by water purchased from Hudson, Derry, Hooksett, Raymond and Manchester.

Pittsfield Aqueduct Company, Inc. supplies water to the Town of Pittsfield. The source of water for the Pittsfield system is Berry Pond located in Pittsfield, New Hampshire. Water from this pond is treated by the Neptune Microfloc package treatment plant.

Southwood Corporation owns land that was transferred from Pennichuck Water Works since 1983. Southwood has sold or developed a protion of this land and continues to own the remainder. Southwood is not regulated by the NH PUC.

The Pennichuck Water Service Corporation is also not regulated by NH PUC. The Service Corp. provides contract management, operation and maintenance services to a variety of water utilities in Massachusetts and New Hampshire.

The following provides additional information relative to the water utilities specifically Pennichuck East, Pittsfield Aqueduct and portions of Pennichuck Water Works that are not within the core system. The following describes the water supply, safe yield, water quality, water treatment facilities and water distribution systems within each of the three water utilities.

2.0 Pennichuck East

The basic information describing the Pennichuck East water system is shown below in Table 2-1.

Table 2-1 Pennichuck East Water System Characteristics

	Pennichuck East Utility[1]
Communities Served	10
Number of Services	4,277
Water Source	Wells[2]
Wells, number	23
Estimated Safe Yield, gallons per minute	795
Pumping Stations, number	16
Booster Stations, number	5
Water Mains, length in miles	111
Fire Services, number	16
Meters, number	4,181
Hydrants, number	371

[1] Date taken from the Pennichuck East 2001 annual report to the New Hampshire Public Utility Commission.
[2] Water is also purchased from Derry, Hudson, Hooksett, Raymond and Manchester.

2.1 Water Supply

Pennichuck East supplies water to the 10 communities as previously shown in Figure 1-1.

The water sources for Pennichuck East are 23 operating wells located throughout the service area. This water is supplemented by water purchased from Manchester, Derry, Hudson, Hooksett and Raymond. Figure 2-1 shows the Pennichuck East communities and the approximate location of the 23 operating wells. Table 2-2 on the following page includes a summary of the characteristics of the Pennichuck East production wells.

The raw water usage by Pennichuck East is presented in Figure 2-2 for the last three years. The data in Figure 2-2 shows water that was produced by wells in the Pennichuck East system, water purchased from the systems noted above and the total usage. As the information shows, the Pennichuck East wells have consistently produced approximate 10 million gallons per month throughout the last 3 years. The remaining water is purchased and ranges from approximately 15 million gallons during the winter months to as much as 35 million gallons during the peak summer months. The trend over the last 3 years has been to rely more heavily on purchased water.

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Pennichuck East
Well Locations

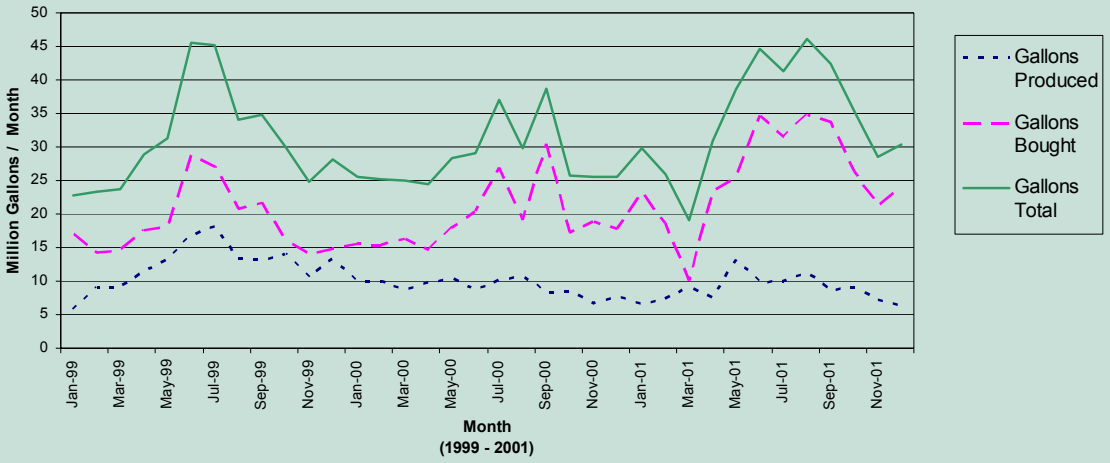
Figure 2-1

Table 2-2 Pennichuck East Production Well Summary

Well ID	Location	Type	Depth (feet)	Safe Yield (gpm)
1	Williamsburg - Pelham	gravel packed	35	200
2	Williamsburg - Pelham	gravel packed	35	100
3	Goldenbook - Windham	driven	46	25
4	Goldenbook - Windham	driven	44	25
5	Goldenbook - Windham	driven	42	15
6	Goldenbook - Windham	driven	50	15
7	W&E - Windham	bedrock	941	50
8	W&E - Windham	bedrock	740	37
9	Avery - Londonderry	bedrock	205	8
10	Farmstead – East Derry	bedrock	245	25
11	Hardwood – Windham	Bedrock	400	2
12	Hardwood – Windham	Bedrock	202	16
13	Beaver Hollow - Sandown	Bedrock	465	20
14	Gage Hill - Pelham	Bedrock	300	27
15	Liberty Tree - Raymond	Bedrock	375	50
16	Liberty Tree - Raymond	Bedrock	625	30
17	Maple Hills - Derry	Bedrock	825	45
18	Maple Hills - Derry	Bedrock	250	50
19	Nesenkeag - Londonderry	Bedrock	400	30
20	Pine Haven - Londonderry	Driven	30	Unknown
21	Pine Haven - Londonderry	Driven	30	Unknown
22	Harvest Village - Londonderry	Driven	385	8
23	Atkinson - Atkinson	Bedrock	680	16.5

Source: 2001 Annual Report of Pennichuck East Utility.

Figure 2-2
Pennichuck East Water Use



Source: Monthly Water Usage provided by Pennichuck through the PUC proceeding process.

Since the water produced by Pennichuck East comes from a number of wells it is important to have a well head protection program that controls land uses in the areas recharging the aquifers. Pennichuck has indicated it is their policy to control, to the extent practicable, the land within 400 feet of each well and to manage land use activity, again to the extent practicable, in the more distant recharge areas. However, it is not clear how this policy is implemented at the various wells in the system.

In order to provide long term protection for the quantity and quality of the groundwater in each aquifer, the following three step process should be undertaken for each well or well system.

1. Conduct a hydrogeologic investigation to determine the extent of the aquifer and its response to various pumping conditions.

2. Map the land uses in the aquifer protection areas.

3. Develop a plan, in coordination with the municipalities where the aquifers are located, to manager the land uses and activities in the aquifer protection areas.

2.2 Safe Yield

The safe yield of a supply system is the amount of water that can be withdrawn during a sustained drought condition. The frequency typically used to define the severity of the drought is 100 years. Table 2-3 lists the safe yield for those wells in each community served by Pennichuck East.

Table 2-3 Pennichuck East Safe Yield Per Municipality

	Number of Wells	Safe Yield (gpm)	Purchase Water
Pelham	3	327	-
Windham	8	185	-
Sandown	1	20	-
Raymond	2	80	Town of Raymond
Derry	3	120	Derry Water Works
Londonderry	5	46	-
Litchfield			Town of Hudson
Hooksett			Hooksett Water[1]
Plaistow			Unknown[1]
Atkinson	1	17	-
Total	23	795	

[1] Distribution Mapping is not available to confirm connections to other communities.

Source: 2001 Annual Report of Pennichuck East Utility.

The data in the Annual Report presented by Pennichuck East to the New Hampshire PUC indicated that the wells that are currently in service have a combined safe yield of approximately 795 gpm. Based on this information, we estimate that this system could reliably produce at least 20 million gallons (mg) per month. Since the PUC report indicates that these wells produced approximately 10 mg per month in 2001, they could increase production and reduce the amount of water purchased from others. The amount of water purchased from others in 2001 range from approximately 10 mg per month in the winter months to 35 mg per month in the summer months.

2.3 Water Quality

Pennichuck East is required to prepare Consumer Confidence Reports on a variety of water quality parameter. The reports for 2001 have been reviewed and the inorganic parameters that are typically tested are included in Table 2-4.

Table 2-4 Pennichuck East Water Quality Data

Parameter	No. of Samples	Range	MCL	No. of Samples Exceeding the MCL
1. Lead, ppb	13	<5 – 10 ppb	15 ppb	None
2. Copper, ppm	13	0.11 – 1.35 ppm	1.3 ppm	1
3. Nitrate as Nitrogen, ppm	7	0.1 – 5.43 ppm	10 ppm	None

ppb = Parts per billion
ppm = parts per million
MCL = Maximum Containment Level

Source: 2001 Consumer Confidence Reports for Pennichuck East Utility.

Samples were taken from the following wells; Williamsburg, Goldenbrook, W&E, Avery, Hardwood, Beaver Hollow, Gage Hill, Green Hills (taken out of service in September 2000), Liberty Tree, Maple Hills, Nesenkeag Hill, Pine Haven, and Harvest Village.

There was one case where copper exceeded the NH DES Maximum Containment Levels (MCL) at the Goldenbrook wells in Windham. There were also other inorganic, organic and radiobiological compounds tested at the wells listed in Table 2-2 and none exceeded the state MCL. No data on bacteria were reported in the Consumer Confidence Reports.

2.4 Water Treatment Facility

Almost all the water produced by Pennichuck East is treated by chlorination, chemical additions and/or filtration. Table 2-5 summarizes the type of treatment at each well or well field. Based on the water quality data reviewed in the previous section, additional treatment requirements are not anticipated in the near future. However, consideration should be given to adding disinfection and filtration to all well systems.

Table 2-5 Pennichuck East Well Treatment

Well ID	System Location	No. of Wells	Treatment
1 & 2	Williamsburg - Pelham	2	C, CA
3 - 6	Goldenbook - Windham	4	C, CA
7 & 8	W&E - Windham	2	C, CA, O
9	Avery - Londonderry	1	C, F, CA, O
10	Farmstead – East Derry	1	C
11 & 12	Hardwood – Windham	2	C, CA, O
13	Beaver Hollow - Sandown	1	C, O
14	Gage Hill - Pelham	1	C, CA, O
15 & 16	Liberty Tree - Raymond	2	C, O
17 & 18	Maple Hills - Derry	2	C, F, CA, O
19	Nesenkeag - Londonderry	1	C, F, CA
20 & 21	Pine Haven - Londonderry	2	O
22	Harvest Village - Londonderry	1	None
23	Atkinson - Atkinson	1	None

C = Chlorination, F = Filtration, CA = Chemical Addition, O = Other

Source: 2001 Annual Report of Pennichuck East Utility.

2.5 Water Distribution System

Pennichuck East supplies water to the Towns of Litchfield, Pelham, Windham, Londonderry, Derry, Hooksett, Sandown, Raymond, Plaistow and Atkinson. Table 2-6 on the following page summarizes the characteristics of the distribution system by community.

The total distribution system for Pennichuck East serves approximately 4,300 customers and consists of approximately 111 miles of distribution and transmission lines and associated pumps, water meters, and hydrants.

Table 2-6 Pennichuck East Distribution System Summary

	No. of Distribution Systems	Inter-Municipality Connections
Pelham	Unknown[1]	Unknown[1]
Windham	5	Derry
Sandown	1	Unknown[1]
Raymond	Unknown[1]	Unknown[1]
Derry	Unknown[1]	Londonderry & Windham
Londonderry	6	Litchfield
Litchfield	1	Hudson & Londonderry
Hooksett	2	None
Plaistow	1	None
Atkinson	1	Unknown[1]

[1] Distribution Mapping is not available to confirm connections to other communities.

Source: 2001 Annual Report of Pennichuck East Utility.

There are only several thousand gallons of storage located throughout the distribution system at pumping stations. Although this is a small amount of storage in the event of an emergency disruption of supply, Pennichuck purchases water from 5 outside sources as previously noted. These sources can be, in some cases, used to supplement supply in the event of a disruption in service. However many of the water systems are isolated and not connected to one of the outside supply sources. For this reason an analysis of each of the distributed systems should be undertaken to assess operations under normal, fire flow and emergency conditions.

3.0 Pittsfield Aqueduct Company, Inc.

Pittsfield Aqueduct Company, Inc. supplies water to the Town of Pittsfield, which services 626 costumers (based on the Annual Report submitted to the PUC dated December 31, 2001).

The basic information describing the Pittsfield Aqueduct Company water system is shown below in Table 3-1.

Table 3-1 Pittsfield Aqueduct Water System Characteristics

	Pittsfield Aqueduct Company[1]
Communities Served	1
Number of Services	626
Water Source	Berry Pond
Safe Yield, gallons per day	350,000
Water Mains, length in miles	13
Meters, number	645
Hydrants, number	70

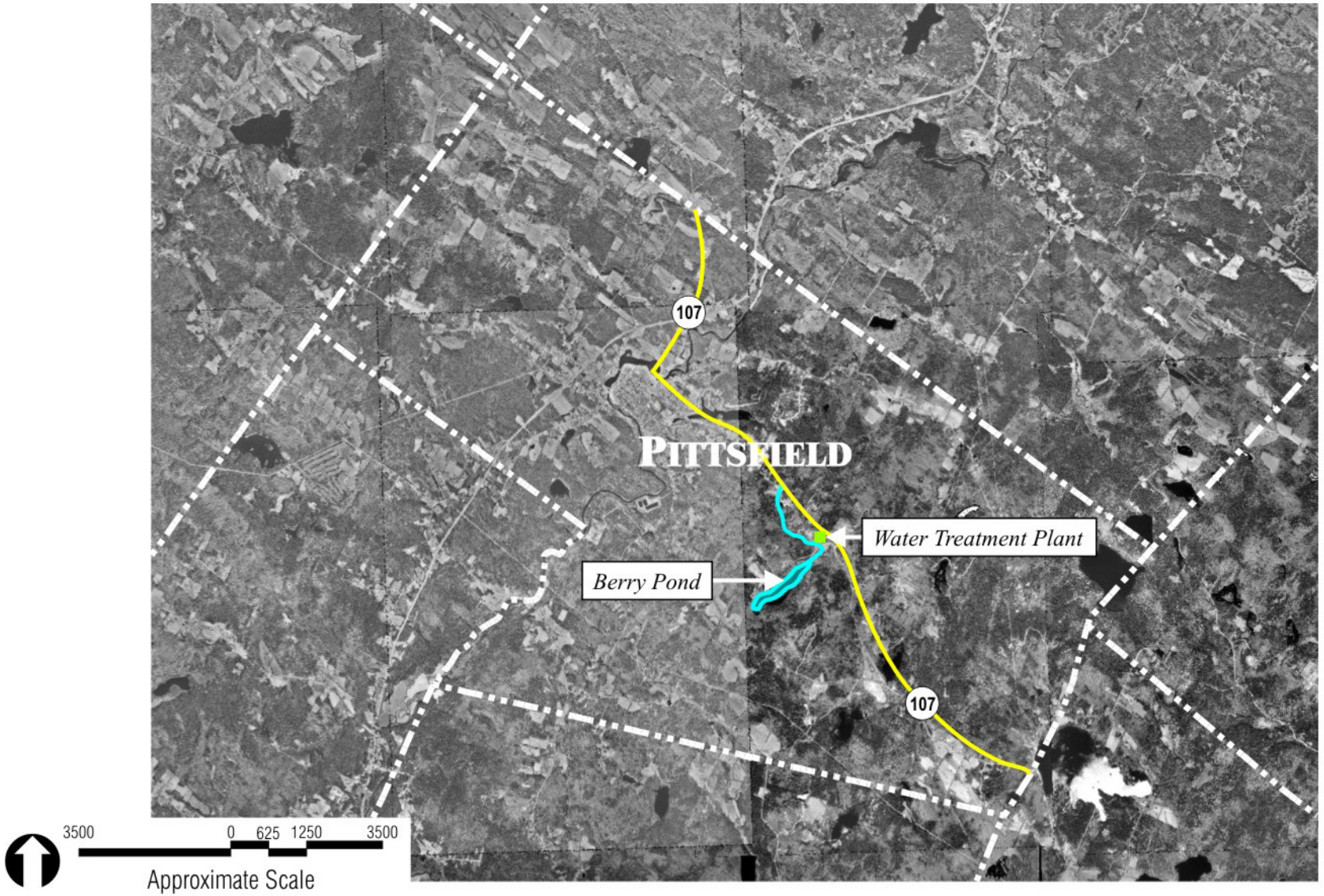
[1] Date taken from the Pittsfield Aqueduct 2001 annual report to the New Hampshire Public Utility Commission and the 2001 Securities and Exchange Commission 10-K Report.

3.1 Water Supply

The sole source of water for the Pittsfield system is from Berry Pond located in Pittsfield, New Hampshire as shown on Figure 3-1. Water flows from Berry Pond through Berry Pond Brook into the supply pond where it is withdrawn by the Pittsfield Water Treatment Plant. The tributary area to Berry Pond is 0.41 square miles (262 acres). Within the watershed, 165 acres of land (63% of the watershed) are owned by Pittsfield Aqueduct.

Pennichuck Corporation should prepare and implement a watershed protection plan for the area tributary to Berry Pond. The plan should be similar to the one developed for Pennichuck Water Works along with the recommended additions noted in the November, 2002 report previously mentioned.

The raw water usage by Pittsfield Aqueduct Company is presented in Figure 3-2 for the last three years. The data in Figure 3-2 shows typical water production of approximately 6 million gallons per month. This production approaches 5 mg per month in the winter months and 7 mg in the peak summer months.



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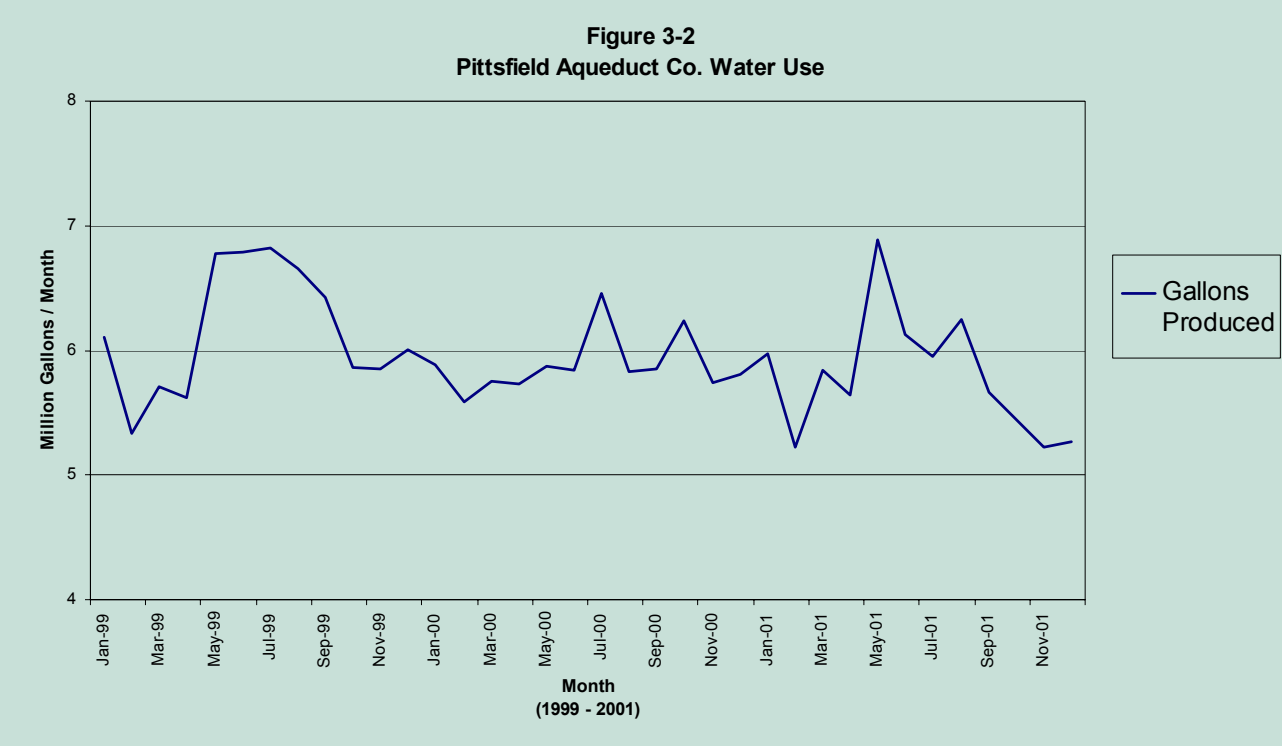
Pittsfield
Water Supply

Figure 3-1



Source: Monthly Water Usage provided by Pennichuck through the PUC proceeding process.

3.2 Safe Yield

The data in the Annual Report presented by Pittsfield Aqueduct Company to the New Hampshire PUC indicated that Berry Pond has a safe yield of approximately 350,000 gpd. This equals approximately 10.5 mg per month. Based on the monthly production shown in Figure 3.2 the system has adequate long term capacity. However, it is anticipated that the system would be stressed on peak summer days during drought conditions without additional storage in the distribution system.

3.3 Water Quality

Pittsfield Aqueduct Company is required to prepare consumer confidence reports on a variety of water quality parameter. The report for 2001 has been reviewed and the parameters that were tested are listed in Table 3-2 on the following page.

Table 3-2 Pittsfield Water Quality Data

Parameter	Sample Results	MCL	No. of Samples Exceeding the MCL
1. Turbidity, NTU	0.57	1.0 NTU	None
2. Barium, ppm	0.0059	2.0 ppm	None
3. Total Trihalomethanes, ppm	10.29	100 ppm	None
4. Lead, ppb	<5	15 ppb	None
5. Copper, ppm	0.15	1.3 ppm	None

ppb = Parts per billion
ppm = parts per million
MCL = Maximum Containment Level

Source: 2001 Consumer Confidence Report for Pittsfield Aqueduct.

All five parameters were within the limits of the NH DES Maximum Containment Levels (MCL).

3.4 Water Treatment Facility

The Pittsfield Water Treatment Plant consists of a Neptune Microfloc package treatment plant located on Berry Pond Road near Route 107 in Pittsfield, New Hampshire as shown in Figure 3-1. Based on the data in the Annual Report presented by Pittsfield Aqueduct Company to the New Hampshire PUC, the plant was built in 1997 and has a capacity of 500,000 gpd. This capacity should be adequate to meet peak daily demands during the summer months with capacity available for growth.

It is not anticipated that major improvements to the water treatment plant will be needed in the near future.

3.5 Water Distribution System

The distribution system for Pittsfield Aqueduct Company consists of approximately 13 miles of distribution and transmission lines, 639 services, 645 water meters, 70 hydrants and a Neptune Microfloc package treatment plant. There is no reported storage in the distribution system.

A hydraulic analysis should be undertaken to develop an understanding of how the system operates under normal, fire flow and emergency conditions.

4.0 Pennichuck Water Works

Pennichuck Water Works, Inc. supplies water to the City of Nashua and limited areas of the Towns of Amherst, Merrimack, Milford, Hollis, Bedford, Derry, Plaistow, Epping, Salem and Newmarket. The core system of Pennichuck Water Works consists of the City of Nashua and those portions of the Towns of Amherst, Merrimack, Milford, and Hollis that are physically connected by the distribution system. The November 1, 2002 report focused on this core system.

The basic information describing the entire Pennichuck Water Works water system is shown below in Table 4-1.

Table 4-1 Pennichuck Water Works System Characteristics

	Entire System[1]	Non-core Systems
Communities Served	11	7
Number of Services	23,634	1,601[2]
Water Source	Pennichuck Brook and Wells	Wells
Wells, number	48	48
Estimated Safe Yield, Gallons per Minute	2,198 - 2,232[3]	2,186
Pumping Stations, number	37	32
Water Mains, length in miles	397	97
Meters, number	23,820	Unknown
Hydrants, number	2,223	223
Water Intake Plant	1	0
Storage Tanks	44	38
Water Treatment Plant	1	0

[1] Date taken from the Pennichuck Water Works 2001 annual report to the New Hampshire Public Utility Commission.

[2] Number of services does not include the portion of Amherst served by a well system.

[3] Safe yield range is based on the ACOE withdrawal permit for the Merrimack River intake facility. See the November 1, 2001 report for more detail.

The following information on water supply, safe yield, water quality, water treatment facilities and water distribution focuses on those portions of Pennichuck Water Works that are not part of the core system (Bedford, Derry, Plaistow, Epping, Salem, Newmarket and a portion of Amherst).

4.1 Water Supply

Pennichuck Water Works supplies water to the 11 communities as previously shown in Figure 1-1. Figure 4-1 shows those municipalities that are not part of the core system and the locations of the wells that supply water within each community. The water sources for Pennichuck Water Works (non core system) are 48 operating wells located throughout the service area. Table 4-2 below provides a summary of the wells within the Pennichuck Water Works system.

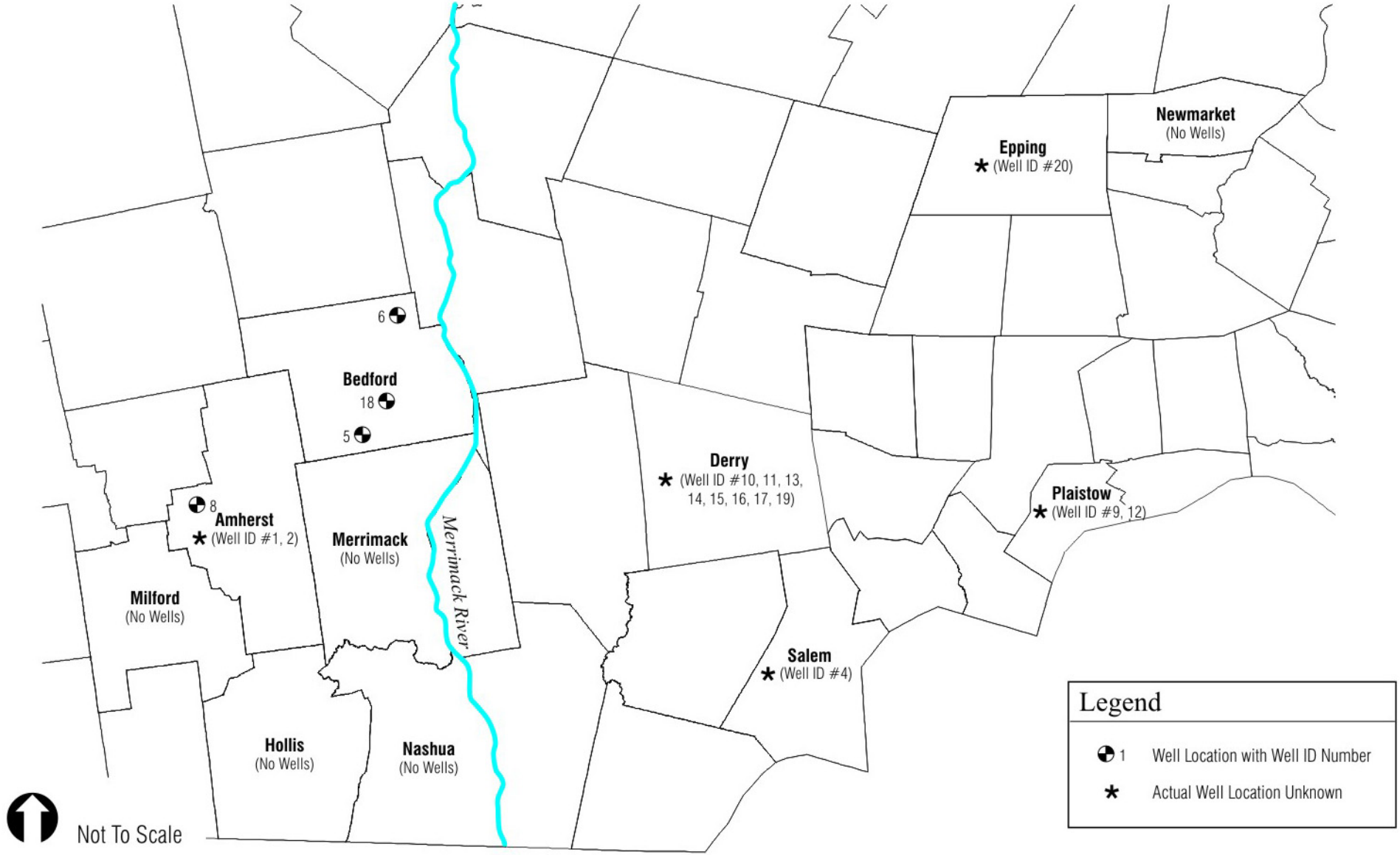
Table 4-2 Pennichuck Water Works Production Well Summary

Well ID	Location	Type	No. of Wells	Depth (feet)	Safe Yield (gpm)
1	Bon Terrain – Amherst	Gravel	1	40	625
2	Amherst - Amherst	Gravel	1	30	225
3	Atherton Commons	AVD System	1	Unknown	Unknown
4	Autumn Woods – Salem	Bedrock	3	275 - 1125	50
5	Cabot Preserve - Bedford	Bedrock	4	300 – 550	100
6	English Woods – Bedford	Bedrock	2	305 - 1200	36
7	Great Bay - Newington	Bedrock	3	375 – 625	126
8	Souhegan Woods - Amherst	Gravel	2	30	115
9	Sweet Hill - Plaistow	Bedrock	1	780	30
10	Richardson Estates- Derry	Bedrock	1	454	23
11	Hi-Lo Estates - Derry	Bedrock	3	185 - 1000	70
12	Twin Ridge – Plaistow	Bedrock	3	500 – 805	56
13	Drew Woods – Derry	Bedrock	7	325 – 1000	255
14	Hubbard – Derry	Bedrock	2	937 – 1000	64
15	Drew Woods 99 – Derry	Bedrock	3	600 – 1000	98
16	Glenn Ridge – Derry	Bedrock	2	215 – 295	59
17	Ashley Commons – Derry	Bedrock	1	845	25
18	Bedford – Bedford	Bedrock, Gravel	3	20 – 473	75
19	Maple Haven- Derry	Bedrock	3	300 – 330	86
20	Glenwoodlands - Epping	Bedrock	2	250	68
	Total		**48**		**2,186**

Source: 2001 Annual Report of Pennichuck Water Works

This water is supplemented by water purchased from Manchester and Milford.

The raw water usage by those communities outside of the core Pennichuck Water Works system is presented in Figure 4-2 for the last three years. The data in Figure 4-2 shows water that was produced by wells listed in Table 4-2.



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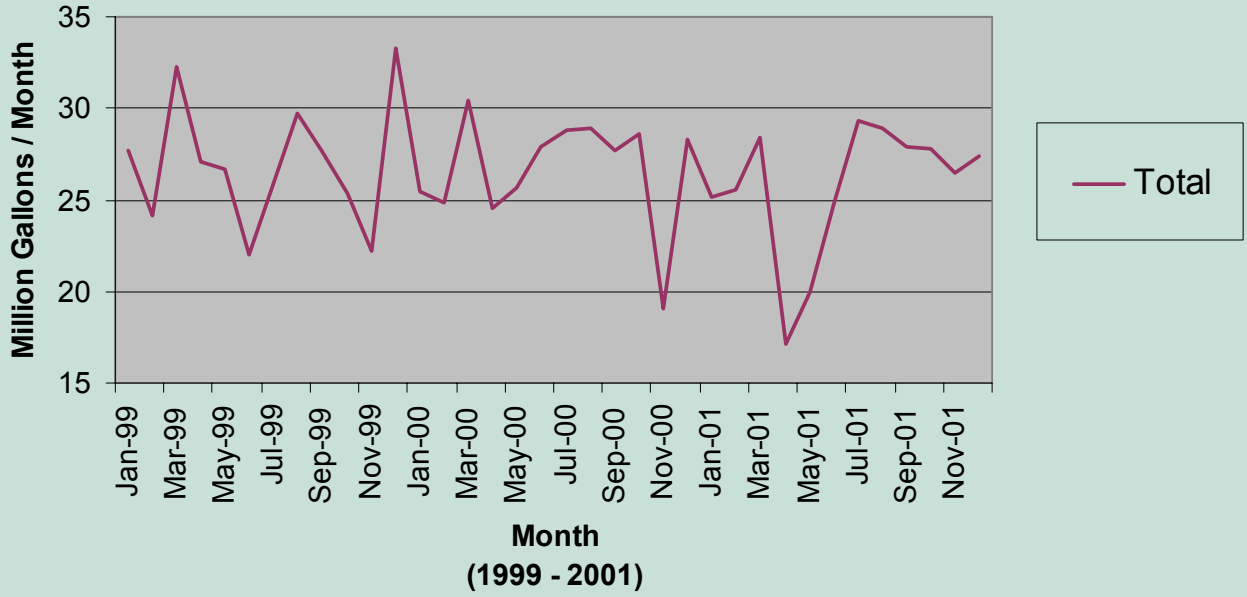
Pennichuck Water Works
Well Locations

Figure 4-1

Figure 4-2
Pennichuck Water Works Water Use



Source: Monthly Water Usage provided by Pennichuck through the PUC proceeding process.

As the water use data shows, the wells in the Pennichuck Water Works system produce approximately 25 mg per month, and this has been consistent over the last 3 years.

4.2 Safe Yield

The safe yield of a supply system is the amount of water that can be withdrawn during a sustained drought condition. The frequency typically used to define the severity of the drought is 100 years.

The data in the Annual Report presented by Pennichuck Water Works to the New Hampshire PUC indicated that the wells that are currently in service have a combined safe yield of approximately 2200 gpm. Table 4-3 provides a summary of the safe yield per municipality. Based on this information, we estimate that this system could reliably produce at least 50 million gallons (mg) per month. The capacity should be adequate to meet the overall average usage of approximately 25 mg per month as shown in Figure 4-2. It should be adequate to meet peak day demand, although each individual well system should be evaluated and tested.

Table 4-3 Pennichuck Water Works Safe Yield Per Municipality

	Number of Wells	Safe Yield (gpm)	Purchase Water
Bedford	9	211	
Derry	22	680	
Plaistow	4	86	
Epping	2	68	
Salem	3	50	
Newmarket			
Amherst [1]	4	965	Milford
Total	44[2]	2,060	

1 A portion of Amherst is physically connected to the core system, while the remainder of Amherst obtains its water from the wells shown above.

2 The location of the Atherton Commons and Great Bay wells are unknown and not included in this listing.

Source: 2001 Annual Report of Pennichuck Water Works.

4.3 Water Quality

Pennichuck Water Works is required to prepare consumer confidence reports on a variety of water quality parameter. The available reports for 2001 have been reviewed and the parameters that are typically tested are included in Table 4-4.

Table 4-4 Pennichuck Water Works Water Quality Data

Parameter	No. of Samples	Range	MCL	Number of Samples Exceeding the MCL
1. Lead, ppb	14	<5 – 8	15	None
2. Copper, ppm	14	<0.1 – 1.09	1.3	None
3. Nitrate as Nitrogen, ppm	8	0.2 – 1.66	10	None

ppb = Parts per billion
ppm = parts per million
MCL = Maximum Containment Level

Source: 2001 Consumer Confidence Reports for Pennichuck Water Works.

The samples were collected at the following well or well fields; Amherst Village, Autumn Woods, Cabot Preserve, English Woods, Great Bay, Souhegan Woods, Sweet Hill, Richardson Estates, Hi-Lo Estates, Twin Ridge, Hubbard, Glenn Ridge, and Maple Haven.

There were no cases where the inorganic compounds noted in Table 4-4 exceeded the NH DES Maximum Containment Levels (MCL). There were also other inorganic, organic and radiobiological compounds tested and none exceeded state MCL's. There was one case where bacteria was tested

and exceeded the state MCL. This was at the Cabot Preserve wells in Bedford, where there is no treatment as noted in the next section.

4.4 Water Treatment Facility

The majority of the water produced by wells within the Pennichuck Water Works system is not treated. There are chlorination and/or chemical additions at five of the well fields. Table 4-5 below summarizes the treatment provided at each well within the Pennichuck Water Works system.

Table 4-5 Pennichuck Water Works Well Treatment

Well ID	Location	No. of Wells	Treatment
1	Bon Terrain – Amherst	1	C, CA
2	Amherst – Amherst	1	C, CA
3	Atherton Commons	1	None
4	Autumn Woods – Salem	3	None
5	Cabot Preserve – Bedford	4	None
6	English Woods – Bedford	2	C, CA
7	Great Bay – Newington	3	None
8	Souhegan Wooods – Amherst	2	C, CA
9	Sweet Hill – Plaistow	1	C
10	Richardson Estates- Derry	1	None
11	Hi-Lo Estates – Derry	3	None
12	Twin Ridge – Plaistow	3	None
13	Drew Woods – Derry	7	None
14	Hubbard – Derry	2	None
15	Drew Woods 99 – Derry	3	None
16	Glenn Ridge – Derry	2	None
17	Ashley Commons – Derry	1	None
18	Bedford – Bedford	3	None
19	Maple Haven- Derry	3	None
20	Glenwoodlands – Epping	2	None

C = Chlorination, F = Filtration, CA = Chemical Addition, O = Other

Source: 2001 Annual Report of Pennichuck Water Works

Consideration should be given to providing disinfection, chemical addition and filtration at all of the wells or well fields.

4.5 Water Distribution System

The non-core systems of Pennichuck Water Works supplies water to the Towns of Bedford, Derry, Plaistow, Epping, Salem, Newmarket and a portion of Amherst. Table 4-6 below summarizes the distribution systems within each municipality.

Table 4-6 Pennichuck Water Works Distribution System

	No. of Distribution Systems	Inter-Municipality Connections
Bedford	7	None
Derry	Unknown[1]	Unknown[1]
Plaistow	Unknown[1]	None
Epping	Unknown[1]	Unknown[1]
Salem	Unknown[1]	Unknown[1]
Newmarket	Unknown[1]	Unknown[1]
Amherst	2	Milford, Nashua

[1] Distribution Mapping is not available to confirm connections to other communities.

Source: 2001 Annual Report of Pennichuck Water Works.

The distribution system servicing these seven municipalities includes approximately 1,836 service connections based on the assumption that the two wells in Amherst service approximately 30% of the total service connections in Amherst. The portion of Pennichuck Water Works outside of the Core system also consists of approximately 97 miles of distribution and transmission lines, 32 pumps, 223 hydrants, and 38 storage facilities. Table 4-7 summarizes the storage facilities and volume of storage available within each of the communities outside of the core Pennichuck Water Works system.

Table 4-7 Pennichuck Water Works Storage Summary

	No. of Storage Facilities	Storage Volume (million gallons)
Bedford	8	0.29
Derry	21	0.26
Plaistow	2	0.02
Epping	2	0.02
Salem	1	0.04
Newmarket	0	0
Amherst	4	1.25
Total	**38**	**1.88**

Source: 2001 Annual Report of Pennichuck Water Works.

The majority of these storage facilities are associated with the 48 wells within the Pennichuck Water Works system. Except for the Bedford, Derry, and Amherst systems there is limited storage in the Pennichuck Water Works system to meet either peak demand or respond to emergency conditions. Since many of these water systems are isolated and not interconnected, an analysis of each system should be undertaken to assess operations under normal, fire flow and emergency conditions.

5.0 Recommendations

Pennichuck East Utility, Pittsfield Aqueduct Company and Pennichuck Water Works should each undertake the following program.

1. **Watershed/Aquifer Protection** to protect the quantity and quality of water. Pennichuck East and Pennichuck Water Works should prepare and implement well head protection programs for each well or well system and Pittsfield should prepare and implement a watershed protection plan for Berry Pond.

2. **Water Treatment,** including disinfection, chemical addition and/or filtration, should be evaluated at all of the wells and well fields in the Pennichuck East and Pennichuck Water Works systems.

3. **Water Distribution System Analysis** to better understand the operation of the storage, pumping and piping in the different water systems. Hydraulic data should be collected and the extent of analysis should vary based on the complexity of each system. It is anticipated that additional storage may be needed in both Pennichuck East and Pittsfield.

Appendix A

Consumer Confidence Reports

Appendix B

Sections of Pennichuck East – 2001 Annual Report

Appendix C

Sections of Pittsfield Aqueduct – 2001 Annual Report

Appendix D

Sections of Pennichuck Water Works – 2000 Annual Report

Appendix E

References